

Sorting of Fish by Size Using Vertical Bar Racks

Investigators

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Summary

The Tracy Fish Collection Facility (TFCF) uses a louver-bypass fish diversion system to separate entrained fish from exported flows. The louver system was designed for juvenile Chinook salmon and striped bass (about 10.16 cm or 4 in long) and functions as a behavioral barrier (Bates *et al.* 1960). Fish sense the turbulence created by the louver wall and turn to avoid it. In doing so, they then are caught in the sweeping flow moving toward and into a bypass. This kind of system is more effective for fish of similar swimming abilities. However, the TFCF currently entrains and salvages 50 species from <1 cm to 100 cm in length. Consequently, predation is a major concern. We tested vertical wall fish separator systems with the objective to pass smaller more vulnerable fish to one holding system while diverting the larger more predaceous fish to another. Our goal is to reduce fish losses to predation within the TFCF. In a laboratory flume, we tested a vertical bar rack with bars oriented horizontally and vertically with the intention to “leak” smaller fish to one holding area and divert larger fish to another.

Problem Statement

Fish of varying sizes and feeding habits are held in concrete channels and holding tanks at the TFCF which increases the opportunity for predation, and losses of the more vulnerable species and sizes. Our objective was to design an upright screen (*i.e.*, vertical) using rounded bars oriented horizontally or vertically that would separate small (<100 mm TL) fish from larger fish using test species as occur at the TFCF.

Goals and Hypotheses

Goal:

1. Determine if fish can be separated by size in flowing water using an upright or vertical bar rack.

Hypotheses:

1. Fish of varying sizes are not separated by size in a laboratory flume with a 60.96-cm (2-ft) bar rack (each bar measures 60.325 mm or 2.375 in) oriented horizontally. Spacing between bars is 19.05 mm (0.75 in).
2. Fish of varying sizes are not separated by size in a laboratory flume with a 60.96-cm (2-ft) bar rack (each bar measures 60.325 mm or 2.375 in) oriented vertically. Spacing between bars is 19.05 mm (0.75 in).

Materials and Methods

Fish release-recovery fish experiments were conducted in a laboratory flume using a range of fish sizes and species. Hydraulic measurements were taken for each configuration to help describe screen approach conditions and performance. Fish were introduced into an area partitioned off with fish screens at the upstream end of the 0.6-m-wide x 0.6-m-deep (2-ft x 2-ft deep) channel. The 0.9-m-long (3-ft) chamber was used to confine the fish between the screens while the flow rate was slowly increased to full strength over a period of 10 min, so that fish could be acclimated to the flow before being released. The downstream screen was then lifted to release the fish and allow them to travel downstream. After 30 min, a crowder was used to force the fish downstream to the leading edge of the separator. After an additional 10 min, flow was shut down and nets were dropped simultaneously to keep fish in their respective areas for counting and measuring. Fish that continued downstream past the separator and into the bypass channel were the non-separated or bypassed fish. Fish that chose to pass through the vertical separator bar rack were considered separated fish. Fish that did not pass into the bypass or through the separator were considered to have not made a decision and therefore were not included in the efficiency count. Analysis of variance or Kruskal-Wallis will be used to test the hypotheses of separation by size.

Coordination and Collaboration

These studies were coordinated with the Tracy Technical Advisory Team.

Endangered Species Concerns

This study was conducted in Denver in the hydraulic laboratory. Thus, there were no endangered species concerns.

Dissemination of Results (Deliverables and Outcomes)

A final Tracy Technical Report Series report will be completed in FY 2010.

Literature Cited

Bates, D.W., O. Logan, and E.A. Pesonen. 1960. *Efficiency evaluation, Tracy Fish Collection Facility, Central Valley Project, California*. Bureau of Reclamation, Sacramento, California.